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AUTHOR Schwartz, Richard G.; Folger, M. Karen
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ABSTRACT

This study proposes that children's phonological behavior at Stage VI of sensorimotor development may show markedly decreased variability compared to children at Stage V. According to Piaget, sensorimotor development during Stage VI is distinguished from preceding stages by the onset of representational ability and ability to form mental combinations. Twenty normally developing children, half of whom were at the "one-word" stage and the other at the "two-word" stage (respectively V and VI), were seen for a minimum of two and a maximum of four sessions within a period of six weeks. A controlled experimental playroom with normal environmental stimuli and a standard set of objects and books were used. The Ordinal Scales of Psychological Development (Uzgiris and Hunt, 1975) were administered, and samples of nonimitative speech were taken. The data were subjected to analyses of production variability, optional processes, and phone classes. Results indicated: (1) Children at Stage VI manifested significantly less production variability than at Stage V; (2) a greater relative number of optional processes were necessary in describing Stage VI phonological behavior; (3) Stage VI children showed a greater number of phone classes per child; and (4) a marked decrease in variability correspondence of word-initial sounds was evident. The study concludes that there is significantly less variability in the phonological behavior of children at Stage VI than at Stage V, suggesting a degree of discontinuity in phonological development. (MHP)

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SENSORIMOTOR DEVELOPMENT AND DESCRIPTIONS OF CHILD PHONOLOGY: A PRELIMINARY VIEW OF PHONOLOGICAL ANALYSIS FOR STAGE I SPEECH

Richard G. Schwartz and M. Karen Folger
Department of Audiology and Speech Pathology
Memphis State University

Ferguson and Farwell's (1975) examination of the phonology of the first fifty words represented a departure from earlier proposals concerning phonological development in children under two years of age. Moreover, it has served to focus our attention on this period of development in phonological acquisition. While Ferguson (1976) has described this as an arbitrarily chosen period, Ingram (1976) has suggested that with respect to cognitive and linguistic development, the first fifty words constitute a naturally separable stage in phonological development. The implications of cognitive developments for descriptions of phonological acquisition during and following this period were the focus of the present investigation.

With the attainment of Stage VI of sensorimotor intelligence, a child begins to gain significant freedom from immediate actions and enters a period characterized by the initial development of representational abilities. For many children, this development is concomitant with the initial use of two-word utterances (Morehead & Morehead, 1974) which in turn is concomitant with the acquisition of the fiftieth word (Nelson, 1973). With the onset of representational thought, the child begins a restructuring of his cognitive knowledge, which results in a consequent restructuring of all behavior stemming from this knowledge. Thus Ingram's argument for the separability of the phonology of the first fifty words would appear to be well-founded. Furthermore, these considerations lead us to question the appropriateness of crediting prerepresentational children with the same knowledge, acquisition, and/or suppression of the complex rules, processes, and systems of contrasts imputed to older children.

Piaget's observations and descriptions of sensorimotor development during Stage VI and the preceding stages lead to specific hypotheses concerning differences one might expect to find in comparing prerepresentational and representational phonological behavior. Stage VI is distinguished from preceding stages of sensorimotor development largely in terms of (1) the onset of representational ability and (2) the onset of the ability to perform mental combinations. The action schemas which became coordinated during Stages IV and V are internalized during Stage VI, thus permitting re-presentation of these schemas. Before the child reaches Stage VI though, he is dependent upon the data of direct perception (Piaget, 1952), or as Morehead and Morehead (1974) point out, the child is limited to "contextual recognition that is static and momentary" (p. 178). These cognitive limitations may be invoked in explaining the observed variability in children's linguistic behavior at this stage. Phonological variability during this period was

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one of the more striking observations reported by Ferguson and Farwell and has also been noted by other investigators (e.g. Ingram, 1976). It should be emphasized that such variability does not simply disappear after the acquisition of the fiftieth word. In spite of the continuation of variability, the onset of the ability of mental re-presentation in Stage VI leads to the hypothesis that the variability of phonological productions should markedly decrease during this period.

The onset of the ability to perform mental combinations may also have significant implications for phonological behavior. As Piaget (1952) notes, the Stage VI child no longer " simply evokes operations already performed, but is able to combine or compare various images in his imagination" (p. 354). Piaget also notes that the combinations established by prerepresentational intelligence "link only successive perceptions and movements, without an overall representation dominating the states" (1962, p. 238). Prior to the emergence of this overall representational ability, it may not be appropriate to credit the child with either a system of sound contrasts or a set of processes (i.e. mental operations) which may be applied systematically. This inability to construct an overall representation renders the lexically based approach of Ferguson and Farwell (1975) a far more tenable description of prerepresentational phonological acquisition than previous approaches.

The ability to perform mental combinations and construct an overall representation may be reflected in a reduced number of apparently noncontrastive sounds revealed in an analysis of children's phone classes. Such a reduction would at least provide indirect evidence of increased systematicity in children's sound contrasts. Furthermore, given these cognitive developments, it would be expected that only then would children begin to have the ability to apply a set of rules or processes consistently. Thus a reduction in the number of 'optional' processes necessary to describe the productions of a particular word form would be an expected consequence of this development.

The purpose of the present investigation was a comparison of the phonological behavior of children at Stage VI of sensorimotor development and the phonological behavior of children who had not yet reached Stage VI. In this paper we will focus on phonological variablity as revealed by production variability, optional processes, and phone classes evidenced in the spontaneous speech of representational and prerepresentational children.

METHOD

Subjects

Twenty normally developing subjects exhibiting language at the level of Stage I as defined by Brown (1973) were included in this investigation. Ten of the children were at the 'one-word' stage (MLU 1.00-1.03) and the remaining ten children had begun producing two-word utterances (MLU 1.11-1.40). The mean utterance lengths as well as the

chronological ages of the children are presented in Table 1. As determined by the parent occupation scale of the Index of Status Characteristics (Warner, Meeker, & Eells, 1960), all but one of the children came from middle class families. The remaining child came from a lower class family.

Procedures

Children were seen for a minimum of two and a maximum of four sessions within a period of six weeks in an experimental playroom under controlled conditions. To approximate a home environment, the playroom was designed to resemble a living room and was furnished as such. In order to provide the children with comparable environmental stimuli during the course of sampling, each child was presented with a standard set of objects and books and a set of situations enacted by the investigators. Additionally, during the second session, each child was administered three of the Ordinal Scales of Psychological Development (Uzgiris & Hunt, 1975): (1) Scale II—The development of means for obtaining desired enviromental events, (2) Scale IV--The development of schemes for relating to objects, and (3) Scale V--The construction of object relations in space.

Samples of nonimitative speech, at least one-hundred utterances in length, were collected from each child. The sample size for each child is given in Table 1. Live transcriptions were made of all the children's utterances as well as relevant adult utterances and situational contexts. In addition, all sessions were video and audio taped. Utterances were considered for analysis if an adult equivalent could be identified for the child's word form(s) or if the investigators agreed there was consistency in the accompanying nonlinguistic contexts.

For the purpose of phonetic transcription, the International Phonetic Alphabet was supplemented by some of the diacritic symbols developed by Bush, Edwards, Luckau, Stoel, Macken, and Petersen (1973). In order to arrive at a transcription for analysis, audio tapes from each session were reviewed and compared with live transcriptions. Disagreements in the broad transcription of an utterance led to its exclusion.

Method of Analysis

Children were grouped according to whether or not they performed at a level indicative of Stage VI across all three scales of sensorimotor development. Children who performed at the level of Stage VI across the three scales were considered to be in Stage VI of sensorimotor development. Children who did not perform at this level across all three scales were labeled Stage V. Synder (1976) has observed that Scale II, the means/ends scale, is the most difficult and typically the last scale on which children will reach Stage VI. Therefore, the scale was criterial for grouping in that it served to determine if a child had truly attained Stage VI. The subject groups are presented in Table 1.

Three major analyses were applied to the data: (1) an analysis of

Table 1: Subject characteristics including: (1) chronological age (C.A.), (2) mean length of utterance (MLU) (3) sample size, and (4) derived productive variability ratio.

Stage VI

Child	C.A.	MLU	Sample Size	Variability Ratio
Misty	22 mos.	1.12	214	1.23
Martha	21 mos.	1.13	458	1.38
Kati	20 mos.	1.22	233	1.26
Brandon	22 mos.	1.19	177	1.28
Gil	20 mos.	1.37	601	1.22
Renee	24 mos.	1.00	176	1.60
Ryan	23 mos.	1.23	818	1.39
	$\bar{X}$ = 21.7	$\bar{X}$ = 1.18		$\bar{X}$ = 1.34
	σ = 1.33	σ = .11		σ = .12

Stage V

Child	C.A.	MLU	Sample Size	Variability Ratio
David	19 mos.	1.11	279	1.54
Erin	14 mos.	1.02	166	2.00
Mandy	18 mos.	1.28	198	1.76
Aaron P.	15 mos.	1.01	150	1.71
Stacy	21 mos.	1.01	214	1.74
Eric	16 mos.	1.03	216	2.10
Forsythe	18 mos.	1.02	163	1.83
Christian	22 mos.	1.40	452	1.50
Aaron H.	16 mos.	1.01	230	1.65
Jenny	16 mos.	1.00	115	1.88
Meredith	21 mos.	1.22	431	1.53
Zack	19 mos.	1.01	359	1.65
Heather	15 mos.	1.01	140	1.66
	$\bar{X}$ = 17.69	$\bar{X}$ = 1.09		$\bar{X}$ = 1.74
	σ = 2.49	σ = .12		σ = .17

production variability, (2) a process analysis, and (3) an analysis of phone classes.

While variability, in the sense of different productions of the same word has been observed and discussed by Ferguson and Farwell (1975) among others, it is not clear what in fact represent different productions for the child. If one were to use an extremely fine system of transcription, variability might be grossly overestimated. Since no empirial evidence concerning this issue is currently available, we chose a more cautious approach to variability. Productions of the same word were defined as different if there were differences in broad transcription or differences involving palatalization, aspiration, or voicing.

Variability was computed in the form of a ratio derived by dividing the total number of different productions for a child by the total number of words attempted. A ratio of 1.00 would indicate no variability, while higher ratios would indicate greater variability. The variability ratios for each child are presented in Table 1.

The process analysis of children's lexical productions focused on processes describing the relationship between consonants in the adult form and consonants in the children's productions. Ingram's (1976) descriptions of phonological processes served as the bases for this analysis. It should be emphasized that this analysis was not undertaken for the purpose of ascribing a set of rules to the children. Rather, the purpose was an examination of the relative frequency of optional processes. Any process which, while necessary to the description of one or more of a child's production(s) of a particular word, was not obligatory in the description of all of the child's productions of that particular word, was considered to be optional. For example, if a child produced the word ball twice without final consonants and once with a final consonant, then final consonant deletion would have occurred twice as an optional process. In order to account for varying sample sizes and thus the total number of processes identified for each child's sample, a ratio was derived for each child. The ratio was arrived at by dividing the total number of occurrences of optional processes by the total number of nonoptional processes.

Finally, an analysis of the word-initial phone classes was performed following the procedure outlined by Ferguson and Farwell (1975). Each word-initial sound and the sound(s) with which it varied (i.e. corresponded) constituted a phone class. Such an analysis serves not only to group together word-initial sounds which correspond, but also serves to separate out those sounds or groups of sounds which do not correspond and therefore may be contrastive. The approach is lexically based and thus all categorizations of correspondence and noncorrespondence are with respect to lexical items. Following a strategy adopted by Ferguson and Farwell, we distinguished as few phone classes as possible. Thus, if anything, biasing the analysis in the direction of underdifferentiation. The phone class analyses were examined in terms of the total number of phone classes per child and the number of

single-member phone classes per child. The former allowed us to infer the degree of differentiation of children's word-initial consonants. The latter indicated the degree to which children's word-initial consonants corresponded or in fact varied.

RESULTS AND DISCUSSION

A comparison of the variability ratios for the children in each of the two groups revealed a significant difference between the groups in the hypothesized direction, t (18) = 5.13, $p < .0005$ (one-tailed). This finding indicated that the children in the Stage VI group manifested significantly less variability in production than the children in the Stage V group. In order to insure that this difference was due to a difference in sensorimotor development rather than a difference between the group in chronological age, subsamples were selected from each groups (C.A. 20 to 22 months) and were compared statistically with regard to variability ratios. A Mann-Whitney U-Test revealed no significant difference between these subsamples. A similar approach was employed in determining whether this difference might be attributed to a difference in mean utterance lengths. No significant difference was revealed between subsamples from each group which included children with mean utterance lengths ranging from 1.22 to 1.88.

The groups also differed significantly in the predicted direction with respect to the relative frequency of optional processes, t (18) = 2.59, $p < .01$ (one-tailed). Thus a greater relative number of optional processes were necessary in describing the phonological behavior of the children in the Stage V group.

There are at least two explanations for the occurrence of optional processes in this analysis. The most obvious possibility is simply that they are the result of the child's variability in the production of word forms. It is also possible that prior to the onset of representation and during the early stages of representational abilities, the child does not only deal phonologically with a particular word in an inconsistent manner, but also is unable to deal with certain sounds, sound classes, or syllabic structures in a consistent manner.

The phone class analyses were also examined statistically. There was a statistically significant difference between the groups, t (18) = 3.72, $p < .005$ (one-tailed); indicating that the children in the Stage VI group evidenced a greater number of phone classes per child. This is not at all surprising since one would expect such an increase as the child develops. What is perhaps more interesting is the fact that the children in the Stage VI group had significantly more single-member phone classes than did the children in the Stage V group, t (18) = 4.05, $p < .0005$ (one-tailed). This result is suggestive of a marked decrease in the correspondence of variability of word-initial sounds.

The results of these analyses all lead to the conclusion that there is significantly less variability in the phonological behavior of children who have reached Stage VI of sensorimotor development, than is

evident in the phonological behavior of children who have not yet reached Stage VI. While we have suggested that an explanation for the occurrence of this variability may lie in a child's cognitive abilities, Stampe (1973) suggests two alternate explanations. He maintains that variability may be the result of the correction of children's pronunciations by adults which interferes with the child's ability to habituate particular substitutions, and/or the lack of conversational opportunity. While these explanations are plausible, there is a lack of supportive data. Furthermore, an explanation based on cognitive abilities not only appears to be supported by this investigation, but is more in line with findings concerning the relationship of other aspects of linguistic behavior and cognitive developments (e.g. Bates, 1976; Ingram, in press).

In conclusion, we have proposed an argument and presented data which suggest a degree of discontinuity in phonological development. It should be emphasized that the discontinuity we are suggesting is not dichotomous in nature. To suggest that representational phonology is an all-or-none phenomenon would not only be intuitively unacceptable, but would run counter to Piaget's views of development. As was mentioned earlier, variability in linguistic behavior does not disappear with the first occurrence of representational behavior, but rather is gradually eliminated. Moreover, complete representational ability does not occur instantaneously, but instead is the result of gradual construction. However, the results of the present investigation do suggest significant differences in the phonological behavior of representational and prerepresentational children.

Given these results, we maintain that prior to the onset of representational ability it would be wise to proceed cautiously in proposing phonological descriptions and analyses. While the rules or systems of contrasts which have been appropriately applied to older children may have great appeal, inappropriate applications may do nothing more than obscure the actual nature of early phonological organization and acquisition. Perhaps even more important though, is the conclusion that, given these differences between the phonologies of prerepresentational children, the simple assumption of continuity in phonological development may be unwarranted.

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